# General Education Assessment and Review Form – Mathematics (Group II) 4/15

Please attach/ submit additional documents as needed to fully complete each section of the form.

## I. Course Information

Department: Mathematics Course Number: M115

Course Title: Probability and Linear Mathematics

Type of Request: New One-time Only X Renew \* Change Remove
Rationale:

\*If course has not changed since the last review and is taught by the same tenure-track faculty member, you may skip sections III-V.

### justification for course level

Normally, general education courses will not carry pre-requisites, will carry at least 3 credits, and will be numbered at the 100-200 level.If the course has more than one pre-requisite, carries fewer than three credits, or is upper division (numbered at the 300 level or above), provide rationale for exception(s).

NA

## II. Endorsement / Approvals

|  |  |  |
| --- | --- | --- |
|  |  |  |

\* Instructor: Lauren Fern (course coordinator) Signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date 01/14/2016
 Phone / Email: (406)-243-5398; fernl@mso.umt.edu

Program Chair: Mathematical Sciences: Emily Stone Signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_
Mathematical Science Chair: Emily Stone Signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_
Dean: Signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_

\*Form must be completed by the instructor who will be teaching the course. If the instructor of the course changes before the next review, the new instructor must be provided with a copy of the form prior to teaching the course.

## iii. Description and Purpose

General Education courses must be introductory and foundational within the offering department or within the General Education Group. They must emphasize breadth, context, and connectedness; and relate course content to students’ future lives: See [Preamble](http://umt.edu/facultysenate/archives/minutes/gened/GE_preamble.aspx)

Probability and Linear Mathematics is a one-semester applications-oriented course which is designed primarily for students majoring in business, management, economics, or the life or social sciences. The content in this class includes the study of linear functions as well as inequalities and their applications to mathematical modeling. Additionally, the students intensively study probability and statistics including, but not limited to: counting techniques, probability (including conditional probability as well as independence), binomial and normal distributions, as well as data analysis and measures of central tendency and variation. The concepts are introduced with the overarching goal of relating to and solving “real-life” applications.

## iv. Criteria

Briefly explain how this course meets the criteria for the group.

Any course which satisfies the mathematical literacy requirement must have as its primary goal to teach mathematical reasoning and problem solving at a college level. Department of Mathematical Sciences approval is required.

M115 clearly satisfies the mathematical literacy requirement.

**1. An appreciation of the beauty of mathematics.**

While beauty is a relative term, the students in this course certainly gain an appreciation of how effective, applicable and widespread the use of mathematics is in daily life as well as their major studies.

**2. An ability to apply mathematical reasoning.**

Because this is an applications based course, the students are continually confronted with word problems; these first need to be “translated” into mathematical statements and then the students need to determine the most appropriate method to solve the problem at hand.

**3. An understanding of how mathematics and statistics are used in many arenas.**

The students are introduced to linear programming, probability and statistics in this class. The general theory is given along with the techniques to solve problems. However the main focus then is for students to apply these techniques to many areas including (but not limited to): business and economics, life sciences, social sciences and other general interest topics.

## v. Student Learning Goals

Briefly explain how this course will meet the applicable learning goals.

Upon completion of the mathematical literacy requirement, a student will be able to apply effectively mathematical or statistical reasoning to a variety of applied or theoretical problems.

The primary learning outcomes for this course include the following:

1. To master the basic concepts of lines, linear systems and linear programming (graphical method only).
2. To understand basic probability concepts: probability models (Venn diagrams, two-way tables), sample spaces with equally likely outcomes (counting), conditional probability (tree diagrams), Bayes’ theorem, binomial probabilities, probability distributions.
3. To understand the rudiments of statistics: measures of center and spread, the normal distribution and the normal approximation to the binomial distribution.
4. To learn how to use the above concepts to solve application problems (this includes to learn to precisely formulate a problem, and to interpret solutions).

The aforementioned learning outcomes thoroughly satisfy the General Education goals for Mathematics. Students firsthand witness the applicability of mathematics and continually apply it to a variety of applications. They learn problem solving throughout the course as they not only have to learn the techniques for each method, but also have to negotiate their way through various exercises and, on their own, need to determine the most appropriate method to solve the problem at hand. Data analysis, probability and statistics encompass the majority of the course content.

## vi. Assessment

How are the learning goals above measured? Describe the measurement(s) used, such as a rubric or specific test questions that directly measure the General Education learning goals. Please attach or provide a web link to the rubric, test questions, or other measurements used.

All sections of this class used multiple assessments including three hourly exams, weekly quizzes, online homework and a two-hour final exam. In the next section, each of the Learning Outcomes for this course is listed, with sample questions from the final exam as well as an assessment of the students’ performance on these questions

### Assessment Findings

**What were the results/findings, and what is your interpretation/analysis of the data?** (Please be detailed, using specific numbers/percentages when possible. Qualitative discussion of themes provided in student feedback can also be reported. Do NOT use course grades or overall scores on a test/essay. The most useful data indicates where students’ performance was stronger and where it was weaker. Feel free to attach charts/tables if desired.)

This assessment is based upon performance of the 490 students who took the final exam. Please note that the questions are grouped by learning goals. Below each of the questions, the average is provided, and is out of 10 points.

**1. To master the basic concepts of lines, linear systems and linear programming (graphical method only).**

1. The new public library of a large town has been ordered to purchase 150 books per month. The library opens with 155,000 volumes (books).

(a) Determine the linear equation that describes the library’s total number of holdings as a function of the number of months since it opened.

(b) Interpret the meaning of the slope of this line.

 (c) How many months after opening, will the library first own 200,000 books?

**AVERAGE: 8.7**

2. Consider the function *z* = 4x – y subject to the following constraints:

 3x + 2y  18

 x - y > 1

 *x, y* > 0

1. Graph the feasible region and label all corner points.
2. Find the values of *x* and *y* that **minimize** *z*; what is the **minimum** value of *z*?

**AVERAGE: 6.7**

3. A contractor builds boathouses in two basic models, the Atlantic and the Pacific. Each Atlantic model requires 1000 ft. of framing lumber, 3000of concrete, and $2000 for advertising. Each Pacific model requires 2000 ft. of framing lumber, 3000of concrete, and $3000 for advertising. Contracts call for using *at least* 8000 ft. of framing lumber, *at least* 18,000  of concrete and *at most* $15,000 worth of advertising. If the construction cost for each Atlantic model is $30,000, and the construction cost for each Pacific model is $40,000, how many of each model should be built to minimize construction costs?

(a) Define the meaning of the variables you will use.

(b) State the objective and give the objective function.

(c) Write ALL constraints for this problem.

(d) Solve.

**AVERAGE: 6.4**

**2. To understand basic probability concepts: probability models (Venn diagrams, two-way tables), sample spaces with equally likely outcomes (counting), conditional probability (tree diagrams), Bayes’ theorem, binomial probabilities, probability distributions.**

1. A crate contains 10 apples: 3 red and 7 green. Three apples are chosen at random (without replacement). Let X denote the number of green apples chosen.

(a) Complete the probability distribution below, please show your work.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  **x** |  **0** |  **1** |  **2** |  **3** |
|  **P(X=x)** |  1/120 = 0.008 |   | 63/120 = 0.525 |   |

 (b) Find the probability of choosing at most 1 green apple (use the table!!!).

**AVERAGE: 8.1**

2. An isolated tribe in New Guinea has been the subject of intensive study by anthropologists. By virtue of their isolation, many members of the tribe display unusual congenital characteristics. Of all the tribal elders, **55%** are exceptionally tall (2m or more), **65%** have a rare form of anemia and **38%** are tall AND suffer from anemia.

(a) Draw a Venn diagram for this problem:

(b) An elder is picked at random. What is the probability the elder is tall and does not suffer from anemia?

(c) An elder is picked at random, **IF** he has anemia, what is the probability that he is tall?

(d) In words describe the following where A represents has anemia and T represents is tall: 

**AVERAGE: 7.6**

3. In a study of color-blindness **52%** were female and **48%** were male. Of the women, **1%** were color-blind; of the males, **6%** were color-blind.

(a) Draw a tree diagram that depicts the results of this study.

 Based on your tree diagram, determine the probability that:

(b) a randomly selected subject was color-blind **IF** they were male.

(c) a randomly selected subject was color blind.

(d) a randomly selected subject was male **AND** color-blind.

(e) **IF** a subject was color-blind, they were female.

**AVERAGE: 7.7**

4. Prior to 9/11, the *New Haven Register*, an important newspaper in Connecticut, conducted a survey of its adult readers to determine their opinion on armed retaliation against countries that have sponsored terrorist attacks against American civilians or bases anywhere in the world. The results of this survey are depicted in the two-way table below:

|  |  |  |  |
| --- | --- | --- | --- |
|  | FAVOR | OPPOSE | TOTAL |
| MALE | 290 | 390 | 680 |
| FEMALE | 110 | 160 | 270 |
| TOTAL | 400 | 550 | 950 |

 Suppose a reader is selected at random, find the following:

1. The probability that the reader is a male.
2. The probability that the reader opposes armed retaliation.
3. The probability that the person is a female AND opposes armed retaliation.
4. The probability that the reader is male **or** they favored armed retaliation.
5. The probability that the reader opposed armed retaliation IF the reader was a male.

**AVERAGE: 8.1**

5. It is estimated that **3.5%** of the general population will live past their 90th birthday. Consider a random sample of **8** graduating college seniors. Assuming the binomial setting, determine the following:

(a) The expected number of these seniors who will live more than 90 years.

(b) The probability that **exactly** **3** seniors live beyond their 90th birthdays? Round to 3 decimal places.

(c) The probability that **at most one** of the seniors live past their 90th birthday. Round to 3 decimal places.

**AVERAGE: 8.4**

**3. To understand the rudiments of statistics: measures of center and spread, the normal distribution and the normal approximation to the binomial distribution.**

1. The average size of a fish in a lake is 11 inches, with a standard deviation of 3 inches. Assume the distribution is normal.

(a) Find the probability of catching a fish between 10 and 15 inches. Round to 3 decimal places.

(b) Find the probability of catching a fish *longer* than 15 inches. Round to 3 decimal places.

(c) What is the minimum fish length that would place it in the top 10% of all such fish in this lake? Round to the nearest (larger) whole number.

**AVERAGE: 6.8**

2. The recovery rate for a certain cattle disease is 25%. Suppose 4500 cattle are afflicted with the disease.

(a) The expected number of cattle that will recover.

(b) The standard deviation.

(c) Using your knowledge of the normal approximation to the binomial distribution, find the probability at least 1100 cattle recover.

**AVERAGE: 7.4**

**4. To learn how to use the above concepts to solve application problems (this includes to learn to precisely formulate a problem, and to interpret solutions).**

1. Tom likes to make and sell t-shirts at fairs and festivals. His cost to produce each t-shirt is $3.50. His total cost to produce 60 t-shirts is $300. He sells them for $6 each.

(a) Find the linear cost function for Tom’s t-shirt production.

(b) How many t-shirts must he produce and sell in order to break even?

(c) How many t-shirts must he produce and sell to make a profit of $500?

**AVERAGE: 8.7**

2. In one of Boston’s city parks there had been a problem with muggings during the summer months. A random sample of 6 days (out of the entire 90-day summer) was compiled and yielded the following data:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Policeman on duty (***x***) | 10 | 15 | 4 | 12 | 7 | 6 |
| Number of muggings (***y***) | 5 | 2 | 7 | 5 | 6 | 8 |

(a) Use your calculator to determine the equation of the least squares line. Round to 2 decimal places!

 (b) If there were **9** police officers on duty, how many muggings would you predict?

(c) The correlation coefficient for this line is -0.92. Given that value, does this line give accurate predictions for the number of muggings given the number of police on duty? You must explain your answer.

(d) Interpret in words the y-intercept of the line found in (a).

**AVERAGE: 7.6**

3. (a) How many five digit numbers can be formed if repetition of digits is not allowed and the number cannot begin with a 0?

(b) A jar contains 7 ‘fig newtons’ and 6 ‘apple bars’. You reach in and pick 4 cookies at random. What is the probability that you pick two of each kind?

(c) A mathematics class had 15 female students and 8 male students. Five students are randomly selected. Find the probability that there will be at least 4 males in the group.

**AVERAGE: 8.4**

### Assessment Feedback

Given your students’ performance the last time the course was offered, how will you modify the course to enhance learning? You can also address how the course could be improved, and what changes in the course content or pedagogy you plan to make, based upon on the findings. Please include a timeframe for the changes.

The more challenging topics were presented earlier in the course in order to capitalize on students’ greater focus and ability to retain the material. This seems to work well with the students’ success. However, as with the previous terms, it took me by surprise how many students did not have a sufficient prior knowledge of linear equations. This is a topic that students should have encountered multiple times in high school as well as in any prerequisite course taken prior to M115.

In general, students performed as expected on the majority of the topics, especially given that this assessment is based upon a final exam. In fact, the averages on the counting techniques, two-way table and the tree diagram were higher than expected. Word problems relating to linear programming as well as graphing systems of inequalities seem to be the biggest hurdle for these students. Therefore, while no major changes regarding coverage are suggested at this point since the content flows beautifully, in the future I would suggest taking more time to review linear equations and basic topics in algebra prior to the linear portion of this course.

A General Education Assessment Report will be due on a four-year rotating cycle. You will be notified in advance of the due date. This will serve to fulfill the University’s accreditation requirements to assess general education.

## vii. Syllabus

Please attach or submit syllabus in a separate file. The learning goals for the Mathematics Group must be included on the syllabus.

The syllabus for this course is included below:

# Mathematics 115 – Section 20

**Grading and Policies Fall 2015**

## Contact Professor:

* **Lecturer:** Lauren Fern
* **Office:** Math 205B
* **Phone:** 243.5398
* **Email:** fernl@mso.umt.edu
* [**Math Webpage**](http://www.math.umt.edu/M115)**:** http://www.math.umt.edu/M115
* **Tutoring:** Free tutoring is available at the tutorial center at Math@Mansfield, located in the Mansfield Library Main Floor next to the Copy Center. Hours will be posted on the website and announced once they have been determined.

## [Catalog Description:](http://www.umt.edu/catalog/mathsci.htm)

(from <http://www.umt.edu/catalog/mathsci.htm>) **U 115 Probability and Linear Mathematics 3 cr.** Offered every term. Prereq.,

MAT 005 with a grade of B- or better or MAT 100 or appropriate placement score. Systems of linear equations and matrix algebra. Introduction to probability with emphasis on models and probabilistic reasoning. Examples of applications of the material in many fields. Credit not allowed for both MAT 115 and MATH 115.

## Learning Goals:

1. To master the basic concepts of lines, linear systems and linear programming (graphical method only).
2. To understand basic probability concepts: probability models (Venn diagrams, two-way tables), sample spaces with equally likely outcomes (counting), conditional probability (tree diagrams), Bayes’ theorem, binomial probabilities, probability distributions.
3. To understand the rudiments of statistics: measures of center and spread, the normal distribution and the normal approximation to the binomial distribution.
4. To learn how to use the above concepts to solve application problems (this includes to learn to precisely formulate a problem, and to interpret solutions).

**General Education Learning Outcomes:**

Upon completion of the mathematical literacy requirement, a student will be able to effectively apply mathematical or statistical reasoning to a variety of applied or theoretical problems.

## Course Content:

1. Sets and Probabilities (Sets, Applications of Venn Diagrams, Basic Concepts of Probability, Conditional Probability; Independent Events, Bayes' Theorem)
2. Counting principles; Further Probability Topics (The Multiplication Principle, Permutations, Combinations, Probability Applications of Counting Principles, Binomial Probability, Probability Distributions; Expected Value)
3. Statistics (Frequency Distributions; Measures of Central Tendency, Measures of Variation, The normal distribution, Normal Approximation to the Binomial Distribution)
4. Linear Functions (Slopes and Equations of Lines, Linear Functions and applications, linear vs. exponential functions)
5. Problem Solving Guidelines, Uses of Percentages, Orders of Magnitude
6. Linear Programming, The Graphical Method (Graphing Linear Inequalities, Solving Linear Programming Problems Graphically, Applications)

## Text:

*Finite Mathematics-11th Custom Edition*, Tan. A graphing calculator is also required. Classroom demonstrations will be done with a TI-83 Plus. A graphing calculator with symbolic capability, such as a TI-89, TI-92 or anything CAS will not be allowed on quizzes or exams.

In order to use the online homework and other helpful features on WebAssign (which came packaged with your text):

|  |  |  |
| --- | --- | --- |
| **Instructor** | **Section** | **Class Key** |
| Lauren Fern | M115, section 20 | umontana 4646 3682 |

To register/login to your webassign account visit: http://webassign.net/login.html

Link for Webassign user guide: <http://assets.cengage.com/pdf/gui_ewa-stu-brief-user-guide.pdf>

## Grading:

Your course grade will be based on 3 exams, 100 points each, for a total of 300 points. There will be ten quizzes of 10 points each with the lowest two dropped. The quiz total will be 150 points (it will be scaled up). There are **no** make-up quizzes. This semester you will also have the option of doing online homework which may count towards 50% of the quiz grade. In other words, you can do the online homework assigned, and that will count for 75 points of your grade, while the quizzes count for the other 75 points. If, on the other hand, you prefer to do the online portion for practice, when needed, but not for a grade, you may have the quizzes count for all of the 150 points. If at the end of the semester your online homework average is higher than your quiz average, we will count the online homework for half of the quiz grade (as mentioned above). If, on the other hand, your online homework average is lower than your quiz average, we will use the quizzes for all of the 150 points and the online homework will have no effect on your grade whatsoever. There will be a 150 point cumulative final exam. All the tests and quizzes are closed book, but calculators are allowed on all tests and quizzes. When a test is returned, there is one week from the date of return for contesting the grading. After that time period the grade will be accepted as final.

| *Grade* | *Grading Scale by Percentages* |
| --- | --- |
| A | 90%+ |
| B | 89-80% |
| C | 79-65% |
| D | 64-55% |
| F | Less than 55% |
| CR |  |

\*\*\* If you are not taking this course as a general education requirement, you must take it for a traditional letter grade (not CR/NCR). A grade of “D-“is considered passing and will earn you credit for the course, BUT it will NOT fulfill your general education requirement and you will have to re-take the class\*\*\*

## Make-ups:

**THERE ARE NO MAKE-UPS** for the turn-in assignments and quizzes, regardless of the reason (e.g. sickness, sports, family emergency, etc.); this is why the lowest two are dropped. Exam make-ups will ONLY be given under special and extenuating circumstances, such as a death in the family or illness, provided that a note from the Health Service or doctor is furnished by the student AND permission is given by me **prior** to the exam. At most one make-up exam will be given. **It is your responsibility to notify me as soon as you know you will miss any exam and it must be either prior to or within 24 hours of the exam.**

## Add/Drop Policy:

The last day to add/drop or change grading option to Audit by Cyberbear is **9/21.**The last day to change sections and to change grading options is **11/2.**This is also the last day to drop. Changes after this deadline and until **12/11** must be done by Petition to Drop/Add after deadline and approved by me, your advisor and the appropriate Dean. Approval requires genuine extenuating circumstances as listed in the university catalog.

 Extenuating circumstances are:

1. Missing a substantial number of classes due to illness, accident or family emergency.
2. A change in work schedule that makes it impossible to attend class or devote adequate time to the course.
3. Registration in the course by error and never attending class.

 Reasons that are not satisfactory include:

1. Forgetting to turn in a drop slip.
2. Protecting your grade point average.

## Incomplete (I) Grades:

To be eligible for an “I”, the following conditions must be met:

1. The student must have been in attendance and passingthe course up to 3 weeks before the semester ends; and
2. The student is unable to complete the course due to extenuating circumstances, which usually means serious illness or death in the family.

 Incompletes are not given under any other circumstances and are always given at the discretion of

 the instructor. See the 2015-2016 catalog for further information.

## Misconduct:

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the [Student Conduct Code](http://www.umt.edu/SA/VPSA/index.cfm/page/1321). Available for review online at <http://www.umt.edu/SA/VPSA/index.cfm/page/1321>

## Disability modifications:

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and [Disability Services for Students](https://www.umt.edu/dss/default.php). If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406.243.2243. I will work with you and Disability Services to provide an appropriate modification.

## Important University-Wide Info and Dates:

* Monday, 7 September: Labor Day. No school.
* Wednesday, 11 November: Veterans Day. No school.
* 25-27 November: Thanksgiving Break. No school.

The following syllabus **is** subject to modifications (and in all probability will be changed due to timing!):

|  |  |  |
| --- | --- | --- |
| **Week** | **Sections** | **Quiz and Exam Dates** |
| 8/31 – 9/4 | 6.1, 6.2, 6.3 |  |
| 9/7 – 9/11 | 6.3, 6.4 | Quiz 1 |
| 9/14 – 9/18 | 7.1, 7.2, 7.3 | Quiz 2 |
| 9/21 – 9/25 | 7.3, 7.4, 7.5 | Quiz 3 |
| 9/28 – 10/2 | 7.5, Review, Test 1 | Test 1: Friday 2 Oct. |
| 10/5 – 10/9 | 7.5, 7.6, 8.1 | Quiz 4 |
| 10/12 – 10/16 | 8.1, 8.2, 8.3 | Quiz 5 |
| 10/19 – 10/23 | 8.4, 8.5 | Quiz 6 |
| 10/26 – 10/30 | 8.5, 8.6, Review, Test 2 | Test 2: Friday 30 Oct. |
| 11/2 – 11/6 | 1.1, 1.2, 1.3 | Quiz 7 |
| 11/9 – 11/13 | 1.3, 1.4, 1.5 | Quiz 8 |
| 11/16 – 11/20 | 2.1-2.6 |  |
| 11/23 – 11/27 | Test 3, Thanksgiving! | Test 3: Monday 23 Nov. |
| 11/30 – 12/4 | 3.1 – 3.3 | Quiz 9, Quiz 10-takehome |
| 12/7 – 12/11 | Catch-up, Review |  |
| MONDAY, 14 DEC. | **\*Final Exam\*** | 1:10 – 3:10 |
|  |  |  |